Remarks:

Claims 1-14 and 16-28 remain pending in the Subject Application. Claims 1-14 and 16-28 stand rejected. Claims 7, 8, 12, 17 and 19 are canceled herein. Claims 1, 10, 11, 13, 16, 18, 20-22, 25 and 26 are amended herein. Claims 1 and 10 are amended to incorporate subject matter from original claim 8, and also from at least paragraph 0077 of the published version of the specification. Claim 11 is amended to incorporate subject matter from original claim 12, and also from at least paragraph 0077 of the as-published specification. Claims 16, 18, 20-22, 25 and 26 are amended to change the claims' dependencies. No new matter is introduced by way of amendment herein.

A. Objections

On page 2 of the Office Action, the Examiner objects to claims 1 and 18 for matters of form. Claims 1 and 18 have been amended herein to directly address these objections. Accordingly, the objections should be withdrawn.

B. Rejections – 35 U.S.C. § 112

On page 3 of the Office Action, the Examiner rejects claims 1-5, 7, 9-13, 16-22 and 26 under 35 USC § 112, first paragraph. The Examiner alleges that:

> Claims 1, 10 and 11 recite the limitations of 'comprising at least 0.2 weight percent aluminum' and 'greater than 0.02 weight percent rare earth metals'. However, the instant specification does not support the implied upper limit of these ranges.

Claims 1, 10 and 11 are amended herein to recite that the total weight of rare earth metals is from 0.02 to 1.0 weight percent. This amendment is supported by at least paragraph 0077 of the as-published specification. Thus, the § 112 rejection with respect to the recited range of rare earth metals has been rendered moot and should be withdrawn. These amendments to claims 1, 10 and 11 are not and may not be considered to be an admission of the propriety of the Examiner's rejection, and the amendments are made exclusively for the purpose of furthering prosecution of the

pending claims and narrowing the remaining issues. Applicant reserves the right to pursue patent protection for the subject matter recited in the original claims by way of continuing and/or divisional patent applications.

With respect to the Examiner's § 112 rejection as applied to the claim language "comprising at least 0.2 weight percent aluminum", Applicant traverses the rejection for at least the following reasons.

Under § 112, first paragraph, the specification must include (1) a written description of the invention, (2) an enabling disclosure, and (3) the best mode of carrying out the claimed invention. MPEP 2162. The three requirements are separate, and the Examiner must establish a separate *prima facie* case for a rejection under any of the three requirements. Here, however, it is not clear under which, if any, of the three requirements the Examiner is attempting to establish a *prima facie* case. The second paragraph on page 3 of the Office Action appears to allege insufficient written description, while the third paragraph appears to allege lack of enablement. In a telephone interview between the Examiner and Matthew Frederick, an attorney for the Applicant, the Examiner focused on enablement.

In order to support a rejection for insufficient written description or absence of an enabling disclosure, the Examiner must present a reasonable basis to question whether the particular § 112 requirement has been met. The Examiner must then support the rejection by a preponderance of the evidence. *See* MPEP 2163(III)(A) and 2164.04. Specific technical reasons underlying the rejection must be presented. MPEP 2164.04. General allegations are not sufficient to support such a rejection. MPEP 2163(III)(A). In the Office Action at page 3, however, the Examiner merely states that "the instant specification does not support the implied upper limit of these ranges." This cursory and wholly unsupported statement does not satisfy the requirement for establishing a *prima facie* rejection under § 112, first paragraph. Thus, the Examiner should withdraw the rejection for that reason alone.

In any case, in the interest of furthering prosecution of the Subject Application, Applicant offers the following observations confirming that the originally filed disclosure

satisfies both the written description and enablement requirement vis-à-vis the aluminum range recited in claims 1, 10 and 11.

1. Written Description

"To satisfy the written description requirement, a patent specification must describe the claimed invention in sufficient detail that one skilled in the art can reasonably conclude that the inventor had possession of the claimed invention." MPEP 2163(I). "An applicant shows possession of the claimed invention by describing the claimed invention with all of its limitations using such descriptive means as words, structures, figures, diagrams, and formulas that fully set forth the claimed invention." *Id.* "There is a strong presumption that an adequate written description of the claimed invention is present when the application is filed." MPEP 2163(I)(A); 2163(II)(A); 2163.03 (emphasis added). "Consequently, rejection of an original claim for lack of written description should be rare." MPEP 2163.03 (emphasis added).

> Possession [of the claimed invention] may be shown in many ways. For example, possession may be shown by describing an actual reduction to practice of the claimed invention.... An adequate written description of the invention may be shown by any description of sufficient, relevant, identifying characteristics so long as a person skilled in the art would recognize that the inventor had possession of the claimed invention.

MPEP 2163(II)(A)(3)(a). "Disclosure of any combination of such identifying characteristics that distinguish the claimed invention from other materials and would lead one of skill in the art to the conclusion that the applicant was in possession of the claimed species is sufficient." MPEP 2163(II)(A)(3)(a)(i). "In claims involving chemical materials, generic formulae usually indicate with specificity what the generic claims encompass. One skilled in the art can distinguish such a formula from others and can identify many of the species that the claims encompass. Accordingly, such a formula is normally an adequate description of the claimed genus." *Id.*

In the case at hand, it is clear that the specification contains an adequate written description of the aluminum range to which the Examiner objects. The range of "at least 0.2 weight percent aluminum" is recited verbatim in paragraph 0076 of the as-published specification. Paragraph 0076 was present in the Subject Application as filed.

Paragraph 0076 unequivocally shows possession of the claimed invention in that the paragraph describes verbatim the claimed aluminum range recited in each of claims 1, 10 and 11.

For at least the above reason, the written description requirement clearly is satisfied with respect to the recited range of "at least 0.2 weight percent aluminum", and there is no need for Applicant to present to the Office further evidence in that regard. Because the aluminum recitation is recited verbatim, it would have been clear to any person that the Applicant was in possession of the recited alloy including "at least 0.2 weight percent aluminum" at the time the Subject Application was filed. Original claims are considered part of the specification, which is one reason why a strong presumption exists that the written description is satisfied with regard to the original claims. Indeed, original claims 1, 10 and 11 recite "at least 0.2 weight percent aluminum" in the specification as filed.

For at least the reasons above, any rejection based on lack of written description should be withdrawn.

2. Enablement

The Supreme Court has interpreted the enablement requirement to require that the specification describe the claimed invention so that any person ordinarily skilled in the art can make and use the invention without undue experimentation. MPEP 2164.01 (emphasis added). "It is not necessary to 'enable one of ordinary skill in the art to make and use a perfected, commercially viable embodiment absent a claim limitation to that effect.'" MPEP 2164. "To demand that [Applicant] ... limit his claims to what he has found will work [at the time the application is filed] ... would not serve the constitutional purpose of promoting progress in the useful arts." MPEP 2164.08 (emphases added). Indeed, "[t]he specification need not contain an example if the invention is otherwise disclosed in such manner that one skilled in the art will be able to practice it without an undue amount of experimentation. MPEP 2164.02.

"The amount of guidance or direction needed to enable the invention is inversely related to the amount of knowledge in the state of the art as well as the predictability in

the art." MPEP 2164.03. Concerning how much experimentation is considered undue, "[t]he test is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine, or if the specification in question provides a reasonable amount of guidance with respect to the direction in which experimentation should proceed." MPEP 2146.06. "When a range is claimed, there must be reasonable enablement of the scope of that range .... The Examiner should determine what each claim recites and what the subject matter is when the claim is considered as a whole, not when its parts are analyzed individually." MPEP 2164.08 (emphasis in original).

Claiming an alloying component of a steel alloy in terms of "at least X weight percent" is a common and accepted claims drafting practice. This is confirmed by a multitude of steel alloy patents claiming alloy components as such. For example, claim 1 of U.S. Patent No. 6,641,780 to Grubb, cited by the Examiner, recites "greater than 25 weight percent chromium". Thus, there can be no question that including a recitation of "at least X weight percent" in the present claims is not necessarily improper.

Presently rejected claims 1, 10 and 11 recite the claimed range of "at least 0.2 weight percent aluminum." On page 3 of the Office Action, the Examiner alleges that "the instant specification does not support the implied upper limits of these ranges." However, all that is required is that the specification enable the claimed range so that one skilled in the art can make and use the invention without "undue experimentation." The Subject Application teaches that electropolishing certain stainless steel alloys can significantly increase the oxidation resistance of the electropolished areas. *See* as-published paragraph 0049. The Subject Application also teaches that aluminum must be present to produce the improvement in oxidation resistance. *See* as-published paragraph 0055. Further, the Subject Application teaches that the scale formed in the more oxidation resistant alloys includes an aluminum-rich, oxidation resistant oxide scale comprising chromium and iron, and having a hematite structure differing from Fe_2O_3, alpha Cr_2O_3 and alpha Al_2O_3. *See*, for example, as-published paragraph 0073. In addition, the Subject Application teaches that in order to achieve the oxidation resistant scale, the alloy must include "at least 0.2 weight percent aluminum." *See* as-published paragraph 0076.

The Subject Application provides several examples of steel alloys including at least 0.2 weight percent aluminum that exhibit improved oxidation resistance when processed according to embodiments of the claimed method. See, for example, Example 4 beginning at as-published paragraph 0074, and Table 6. As noted above, a patent applicant is not required to limit claims merely to embodiments found to work at the time the application is filed. Instead, the specification need only provide reasonable guidance as to the direction in which experimentation should proceed. The patent examiner must consider what each claim recites when considered as a whole, and not when its parts are analyzed individually. As a whole, claims 1, 10 and 11 recite a ferritic stainless steel including the following:

	from	to
chromium	16	30
rare earth metals	0.2	1
aluminum	0.2	
TOTAL		31

Therefore, considering only what is specifically recited in those claims, the claims might be considered directed to an alloy including from 0.2 weight percent to a theoretical maximum of 69 weight percent aluminum. However, one of ordinary skill in the art would know that, at the very least, a certain concentration of iron must be present in a ferritic stainless steel. The inclusion of iron would necessarily lower the theoretical maximum level of aluminum in the claimed steel. One of ordinary skill need only experiment with varying aluminum levels in order to determine which levels provide the desired oxide scale on the steel when the claimed method is conducted. The desired scale and test methods for identifying the scale are described in detail in the Subject Application. This type of experimentation is routine, may readily be conducted by one having ordinary skill, and is not "undue." Because one having ordinary skill may readily conduct the claimed methods and produce the results recited therein without "undue experimentation", the specification of the Subject Application clearly is enabling.

For at least the reasons above, any rejection based on lack of enablement should be withdrawn.

C. Rejections – 35 U.S.C. § 103 (a)

1. Claims 1-5 and 9-10

Claims 1-5 and 9-10 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,641,780 to Grubb ("Grubb"). Applicant traverses this rejection for the following reason. Grubb and the Subject Application were, at the time the invention of the Subject Application was made, owned by ATI Properties, Inc. *Applicant acknowledges the response on page 18 of the Office Action, and hereby submits that a proper recitation of common ownership is submitted herein.*

Pursuant to § 103(c), because Grubb is only available as prior art under § 102(e) (Grubb was issued after the filing date of the Subject Application), Grubb is disqualified as § 103(a) prior art against the Subject Application. *See* MPEP § 706.02(l)(2); 2146. Therefore, Applicant respectfully requests withdrawal of the rejection of claims 1-5 and 9-10 under § 103(a) based on Grubb.

2. Claims 7, 11-13, 16-19, 21, and 25-26

Claims 7, 11-13, 16-19, 21, and 25-26 stand rejected under § 103(a) as being unpatentable over Grubb in view of U.S. Patent No. 2,692,853 to Gamble ("Gamble"). Applicant traverses this rejection for the following reason. Grubb and the Subject Application were, at the time the invention of the Subject Application was made, owned ATI Properties, Inc. *The Applicant acknowledges the response on page 18 of the Office Action, and hereby submits that a proper recitation of common ownership is submitted herein.*

Pursuant to § 103(c), because Grubb is only available as prior art under § 102(e) (Grubb was issued after the filing date of the Subject Application), Grubb is disqualified as § 103(a) prior art against the Subject Application. *See* MPEP § 706.02(l)(2); 2146. Therefore, Applicant respectfully requests withdrawal of the rejection of claims 7, 11-13, 16-19, 21, and 25-26 under § 103(a) over Grubb in view of Gamble.

3. Claims 1-5 and 9-10

Claims 1-5 and 9-10 stand rejected under § 103(a) as being unpatentable over Japanese reference JP 10-280103 to Takehiro ("Takehiro").

The U.S. Patent and Trademark Office has updated the MPEP in light of the Supreme Court's decision in *KSR International Co. v. Teleflex Inc.*, 82 USPQ2d 1385 (S. Ct., 2007). The MPEP now includes revised guidelines for determining obviousness under § 103 ("Guidelines"). The Guidelines reiterate that the framework for the objective analysis for determining obviousness lies in *Graham v. John Deer Co.*, and that obviousness is a question of law based on the following three underlying factual inquiries:

> (1) Determining the scope and content of the prior art;
>
> (2) Ascertaining the differences between the claimed invention and the prior art; and
>
> (3) Resolving the level of ordinary skill in the pertinent art.

See MPEP 2141(II). The Guidelines further articulate the following concerning the Examiner's role in assessing obviousness:

> When making an obviousness rejection, Office personnel must therefore ensure that the written record includes findings of fact concerning the state of the art and the teachings of the references applied.
>
> Once findings of fact are articulated, Office personnel must provide an explanation to support an obviousness rejection under 35 U.S.C. 103. 35 U.S.C. 132 requires that the applicant be notified of the reasons for the rejection of the claim so that he or she can decide how best to proceed. *Id.* (emphasis added).
>
> The key to supporting any rejection under 35 U.S.C. 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious. The Supreme Court in *KSR* noted that the analysis supporting a rejection under 35 U.S.C. 103 should be made explicit. *See* MPEP 2141(III) (emphases added).

The Guidelines also state as follows:

> Prior art is not limited just to the references being applied, but includes the understanding of one of ordinary skill in the art. The prior art reference (or references combined) need not teach or suggest all claim limitations; however, Office personnel must explain why the difference(s) between the prior art and the

> claimed invention would have been obvious to one of ordinary skill in the art.... The gap between the prior art and the claimed invention may not be 'so great as to render the [claim] nonobvious to one reasonably skilled in the art.'

MPEP 2141(III) (emphasis added).

Of the rejected claims, claims 1 and 10 are independent. In the case at hand, and as discussed below, the gap between the teachings in the cited references and the subject matter recited in independent claims 1 and 10 is "so great as to render the [claims] nonobvious to one reasonably skilled in the art."

Claim 1 requires "electropolishing at least one surface of the ferritic stainless steel." Takehiro does not teach or suggest electropolishing. The Examiner has provided no explicit rationale in the Office Action as to why one of ordinary skill in the art, when considering Takehiro alone, would be motivated to electropolish a ferritic stainless steel. The Examiner alleges that Takehiro teaches "peeling off the surface of oxide scale" as a surface modification. However, an oxide scale "peeling" process does not refer to or suggest electropolishing. Thus, the gap between the teachings in the cited reference and the subject matter recited in independent claims 1 and 10 is "so great as to render the [claims] nonobvious to one reasonably skilled in the art". Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 1-5 and 9-10.

4. Claims 7, 11-13, 16-22 and 25-26

Claims 7, 11-13, 16-22 and 25-26 stand rejected under § 103(a) as being unpatentable over Japanese reference JP 10-280103 to Takehiro ("Takehiro") in view of U.S. Patent No. 2,692,853 to Gamble ("Gamble") and/or U.S. Patent No. 2,338,321 to Faust ("Faust"). Of these rejected claims, claim 11 is the single independent claim. Claims 12, 13, 16-22 and 25-26 directly or ultimately depend from claim 11. The Examiner cites Gamble and Faust in an attempt to cure deficiencies in Takehiro with respect to electropolishing. Applicant traverses this rejection for the reasons set forth below. Considering the amendments herein, Applicant considers the following arguments relevant to all currently pending claims, including independent claims 1, 10 and 11.

As discussed above, the Guidelines recently included in the MPEP discussing how examiners are to assess obviousness require that an Office Action include the examiner's findings pursuant to the *Graham v. John Deere* factors, as well as a "clear articulation of the reason(s) why the claimed invention would have been obvious." In *KSR International Co. v. Teleflex Inc., supra,* the Supreme Court ruled that to support an obviousness rejection, an analysis of obviousness should be made wherein the patent examiner assesses "whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." The Court further stated that "[t]o facilitate review, this analysis should be made explicit." Also, in response to the *KSR* decision, prior to the PTO's publication of the Guidelines, the Deputy Commissioner for Patent Operations stated in a May 3, 2007 memo to the Patent Office's Technology Center Directors that "in formulating a rejection under 35 U.S.C. § 103(a) based upon a combination of prior art elements, it remains necessary to identify the reason why a person of ordinary skill in the art would have combined the prior art elements in the manner claimed."

Therefore, the case law and the MPEP hold that an examiner cannot arbitrarily combine teachings of prior art references so as to achieve a claimed invention. Instead, there must be a rational basis for an examiner to combine reference teachings in a § 103(a) rejection, and the examiner must identify that basis in an Office Action. Thus, as the case law and the MPEP amply support, absent there being a stated rational basis for combining reference teachings in the manner an examiner sets forth in an obviousness rejection, the examiner has not established a *prima facie* case that the claimed invention would have been obvious. *See also* MPEP 2142. ("The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness.... However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art.") ("The initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done."); MPEP 706.02(j) ("After indicating that the rejection is under 35 U.S.C. 103, the examiner should set forth in the Office action ... (D) an explanation why one of ordinary skill in the art at the time the invention was made would

have been motivated to make the proposed modification."); *also see Ex parte Clapp*, 227 USPQ 872, 973 (BPAI 1985) ("To support the conclusion ... the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references").

In the case at hand, the Examiner has not established a *prima facie* case of obviousness for at least the reason that he has not identified a rational basis why one of ordinary skill in the art would have electropolished or otherwise electrochemically modified the steel of Takehiro in light of Gamble and Faust. The Examiner alleges that it would have been obvious to combine the references to achieve a mirror-like finish, but the Examiner does not give a rational basis for why this would have been obvious, as well as beneficial, as the claimed invention relates to improved performance of ferritic stainless steels in high temperature oxidizing environments.

To begin, page 11 of the Office Action demonstrates a fundamental misunderstanding of the invention recited in claims 1, 10 and 11. The Examiner alleges that Takehiro teaches a steel with an overlapping composition. Then, the Examiner identifies the deficiency of Takehiro as not teaching electrochemically modifying a surface of the steel to remove the scale. The purpose of electrochemical modification in claims 1, 10 and 11, however, is not to remove existing scale, but rather to induce the formation of a particular kind of scale. With this understanding, the fundamental issue, then, is whether it would have been obvious to electropolish the steel of Takehiro in light of Gamble and Faust.

Despite the explanation given in the previous response filed by the Applicant, the Examiner continues to assert that one of the motivating factors for combining Takehiro with Gamble is Gamble's recitation of "a bright mirror-like polished surface." The Examiner maintains that this is a motivating factor, but does not provide an explicit rationale why this would have motivated one of ordinary skill in the art to use a bright mirror-like ferritic stainless steel part in a high temperature oxidation environment. As discussed herein, the finish (*i.e.*, appearance) of a steel was wholly irrelevant as it relates to use of the steel solid oxide fuel cells (SOFCs).

Steels can be electrochemically modified to produce a shiny, mirror-like (specular) finish. In the medical and pharmaceutical arts, steels also can be electrochemically modified to provide a smooth surface that is substantially free of voids to help keep the surface clean. The Examiner alleges that it would have been obvious to electrochemically modify the surface of the steel of Takehiro in order to remove scale and obtain a "bright mirror-like polished surface" as disclosed by Gamble. Neither of these known potential benefits of electrochemically modifying the surface of certain steels, however, are the focus of the method of claims 1, 10 and 11. Instead, the present inventor unexpectedly discovered that practicing the method of claims 1, 10 and 11 significantly improves high temperature oxidation resistance of the modified surface. Electrochemical modification of the steel of claims 1, 10 and 11 unexpectedly produces a surface that develops a beneficial oxide scale under high temperature oxidizing conditions, a scale that provides significantly improved high temperature corrosion resistance relative to untreated identical steels. The Examiner has not identified why one of ordinary skill would have combined the cited art with the objective of obtaining the same result. Thus, the Examiner has not established a *prima facie* case that the rejected claims recite inventions that would have been obvious. In other words, the Examiner has not made explicit why the knowledge that electropolishing makes certain steels "shiny" would have motivated one of ordinary skill to subject a ferritic stainless steel to an electropolishing process to improve performance in a high temperature oxidizing environment.

In the Office Action, the Examiner cites Faust for the first time in the prosecution. The Examiner alleges that Faust discloses an electropolished ferritic stainless steel having improved corrosion resistance. This is not correct. Faust does not disclose a ferritic stainless steel. Further, the Subject Application teaches improvement in high temperature oxidation resistance, while Faust does not address this property.

There are many steel types. Examples include plain carbon, austenitic, ferritic, martensitic, and duplex steels. One of ordinary skill in the art would be familiar with the distinct general chemical and physical properties of each unique type of steel. One of ordinary skill knows that, as a general matter, "ferritic" stainless steels (as recited in

claims 1, 10 and 11) contain greater than 11.5 weight percent of the alloying element chromium. Faust, on the other hand, teaches a plain carbon steel "having a total of not over 6% of alloying ingredients." *See* column 2, lines 3-6. One of ordinary skill understands the significant differences between plain carbon steel and ferritic stainless steel.

In terms of high-performance steels, the plain carbon steel described in Faust, which issued in 1944, is an "ancient" development. Fuel cells had not been invented at that time, and at that time plain carbon steels were not considered for use in corrosive applications by anyone of ordinary skill. Generally, the scale that forms on a stainless steel acts as a protective layer that slows corrosion significantly. Under ambient temperatures, this scale may operate to suitably protect the integrity of a stainless steel. A typical ferritic stainless steel forms chromium oxide, while the invention of claims 1, 10 and 11 produces an aluminum-rich oxide scale on the ferritic alloy. When plain carbon steel such as described in Faust oxidizes, however, an iron oxide scale is formed. The iron oxide scale formed on a plain carbon steel is not a corrosion protective layer. The growth of the iron oxide scale on a plain carbon steel accelerates under corrosive conditions, even at ambient temperatures, eventually corroding all of the steel and causing it to disintegrate. Therefore, plain carbon steels generally are only used for structural members that are protected from corrosive environments and are not subjected to highly oxidizing temperatures. Faust includes only a single reference to corrosion resistance: "Surfaces that have been electropolished in accordance with my method are more amenable to good electroplating than a mechanically polished surface and are more resistant to corrosion." One having ordinary skill would understand this reference to "corrosion" to refer to low temperature aqueous corrosion, and not to high temperature corrosion. It is clear that one of ordinary skill would not consider a patent relating to plain carbon steel at all relevant to ferritic stainless steels generally, and also would not consider a reference to "corrosion" in such a patent as being related to the high temperature corrosion resistance properties of ferritic stainless steels.

Accordingly, for at least the reasons above, the Examiner has not established a *prima facie* case that claims 7, 11-13, 16-22 and 25-26 would have been obvious over Takehiro in view of Gamble and/or Faust.

Assuming for the sake of argument only that the Examiner has established a *prima facie* case of obviousness, such a case is clearly rebutted by secondary considerations inasmuch as the corrosion resistance improvements obtained by the claimed method are wholly unexpected and significant. Applicant attaches to this response the previously-submitted Declaration of Dr. Michael P. Brady ("the Brady Declaration"), a senior researcher at Oak Ridge National Laboratory, Oak Ridge, Tennessee. As discussed in the Declaration, Dr. Brady has substantial experience in the area of oxidation of stainless steels and other alloys, has evaluated and developed ferritic stainless steels and related alloys for use in solid oxide fuel cells, and is experienced with electropolishing and other surface preparation techniques.

In the Office Action, the Examiner attempts to undermine and discredit the evidentiary weight of the Brady Declaration. The Examiner does this primarily with a reliance on Faust. The Examiner alleges by reference to Faust that it was known to improve oxidation resistance of steels by electropolishing. As discussed above, however, Faust is irrelevant to the claimed invention. Dr. Brady attests that he was not aware of any findings that electropolishing enhances high temperature oxidation resistance of ferritic stainless steel. As discussed above, Faust relates to plain carbon steels and does not address high temperature oxidation resistance. Thus, the statements in Dr. Brady's declaration cannot be discounted.

Further, in reference to the Brady Declaration and elsewhere throughout the Office Action, the Examiner alleges that certain elements recited in the claims of the Subject Application describing the scale that forms under high temperature oxidizing conditions "would not be an active step." Here, the Applicant agrees with the Examiner. The recitation of the type of scale formed by the steps recited in independent claims 1 and 10 enables one of ordinary skill to characterize and evaluate a property of the steel processed by the method recited in the claims. The step of electropolishing, however, is clearly an "active" step of the claimed method. Applicant respectfully submits that the

Examiner should simply focus on the arguments contained herein and make explicit why one of ordinary skill in the art would have found it obvious to electropolish the recited ferritic stainless steel as recited in the claims under examination.

As stated in MPEP § 2141.01, "Objective evidence of secondary considerations such as unexpected results ... and skepticism of experts are relevant to the issue of obviousness and must be considered in every case on which they are present. When evidence of any of these secondary considerations is submitted, the examiner must evaluate the evidence." The MPEP also states that "A greater than expected result is an evidentiary factor pertinent to the legal conclusion of obviousness ... of the claims at issue." MPEP § 716.02(a).

In the case at hand, *ferritic stainless* steel having the composition recited in claims 1, 10 and 11 and treated by the methods of those claims unexpectedly exhibits substantially improved *high temperature corrosion resistance*. In fact, as supported by the Brady Declaration, the methods produce a significant improvement in corrosion resistance in a situation in which those of ordinary skill would have expected a diminished result. This fact is significantly pertinent to establishing the nonobviousness of the claimed invention. *See, e.g., In re Corkill*, 711 F.2d 1496 (Fed. Cir. 1985) ("[T]he claimed combination showed an additive result when a diminished result would have been expected. This result was persuasive of nonobviousness."). At the time the Subject Application was filed, as supported by the Brady Declaration, the conventional belief in the art was that an electropolished (*i.e.,* smooth) *ferritic stainless* steel surface would have a decreased level of *high temperature* corrosion resistance relative to the same steel surface processed to have a "rough" or mechanically deformed surface. In support of this fact, Applicant attaches the following two references, which are also referenced in the attached previously-submitted Brady Declaration:

- C. S. Giggins et al., "The Effect of Alloy Grain-Size and Surface Deformation on the Selective Oxidation of Chromium in Ni-Cr Alloys at Temperatures of 900° and 1000 °C", 245 Transactions of the Metallurgical Society of AIME at 2509-2514 (December 1969) (hereinafter "Giggins").

- J. M. Rakowski et al., "The Effect of Surface Preparation on the Oxidation Behavior of Gamma TiAl-Base Intermetallic Alloys", 35 Scripta Materialia at 1417-1422 (1996) (hereinafter "Rakowski").

Both Giggins and Rakowski teach the advantage of a mechanically deformed (*i.e.*, non-smooth) surface over an electropolished surface in regards to oxidation resistance. As described in Rakowski and as supported by the Brady Declaration, it was believed that mechanically deforming the surface of a stainless steel promotes selective oxidation of alloy elements, such as chromium, as a result of the numerous grain boundaries present on the deformed surface, which provide a "short circuit path" to the surface. Rakowski at 1421. In other words, because of the relatively numerous grain boundaries present near the deformed surface, chromium can readily diffuse to the steel surface. Thus, specimens having deformed (non-smooth) surfaces were found to form a corrosion-protective scale and their oxidation rate constants were about a factor of three smaller than those for electropolished (smooth) samples of the same steel. As noted in Giggins, "fine-grained or grit-blasted (mechanically deformed) specimens were always observed to oxidize slower than electropolished specimens." Giggins at 2514 (emphasis added).

Based on the above conventional belief in the art at the time the Subject Application was filed, and as set forth in the Brady Declaration, it was surprising and unexpected to discover that the electrochemically modified *ferritic stainless* steel of claims 1, 10 and 11, processed by the methods therein, actually exhibited substantially improved *high temperature* oxidation resistance compared with untreated, ground, polished, or otherwise mechanically deformed samples of the same steel. These findings are clearly set forth in the specification of the Subject Application as filed and were contrary to the existing conventional belief, as shown by Giggins and Rakowski, and as confirmed by the attached Brady Declaration. Electrochemical modification according to claims 1, 10 and 11 removes material from the treated alloy surface, providing a smoother surface with a reduced level of shape irregularities. Because the methods recited in claims 1, 10 and 11 provide a smoother surface, those having ordinary skill would have expected the method of those claims to result in a reduced

level of high-temperature oxidation resistance relative to a mechanically deformed surface.

The present inventor amply demonstrated the surprising and unexpected results of the methods of claims 1, 10 and 11 in paragraphs 0052-0063 of the specification of the Subject Application. Specifically, the inventor tested *ferritic stainless* steel samples having a chemistry within the ranges recited in those claims for *high temperature* oxidation resistance after the samples received several different surface treatments, including a standard "mill" surface, polishing with 120 grit SiC paper, and electropolishing. As discussed in the Subject Application, the rate of oxidation of the electropolished surfaces was unexpectedly found to be several orders of magnitude lower than that of the mechanically finished mill surface and the polished surface.

A shiny, specular surface can be obtained on a *ferritic stainless* steel by methods other than electropolishing. In the Subject Application, the present inventor performed tests to confirm that the improved *high temperature* oxidation resistance of the *ferritic stainless* steel was attributed to electropolishing, and not a shiny, specular surface in general. In these tests, the inventor treated a surface of a sample of the alloy recited in claims 1, 10 and 11 using successively finer grinding papers and lapping compounds, ending with a step of polishing the sample surface with a 1 micron diamond paste. The final surface had the approximate physical smoothness and specular appearance of an electropolished surface. Unexpectedly, the electropolished surface still exhibited an order of magnitude reduction in oxidation weight change relative to the ground and polished sample. This surprising and significant result demonstrates that the substantially improved high temperature oxidation resistance provided by the method of the claims is not merely a function of surface smoothness (which, in any case, would be counter to the then-prevailing conventional wisdom) or the reflective appearance of the samples.

As further described in the Subject Application, the unexpected and surprising benefits of electrochemically modifying a surface of the steel as recited in claims 1, 10 and 11 were demonstrated by first electropolishing and then lightly mechanically polishing with 1 micron diamond paste a steel having the composition recited in the

claims. Despite maintaining the specular finish of an electropolished sample, the improvement in oxidation resistance provided by electropolishing the sample was reversed after mechanically polishing the electropolished surface with the diamond paste. This result indicated that electropolishing the steel of the claims somehow advantageously modified the surface in a way other than merely by smoothing the surface. Again, this was an unexpected and nonobvious result.

The foregoing tests, which all are described in detail in the specification of the Subject Application, reinforce the fact that there are multiple methods to achieve a mirror-like, specular finish on ferritic stainless steels. However, mechanical polishing, such as with a diamond paste, despite producing a mirror-like finish visually indistinguishable from an electropolished surface, does not produce the improved oxidation resistance achieved by the method recited in claims 1, 10 and 11. Although providing a mirror-like finish on an alloy surface is not the objective of the method of claims 1, 10 and 11, it is, of course, a tertiary result. If achieving a shiny surface were truly the objective of the invention of the claims, then it would not matter by what method it was achieved. Clearly, however, the invention of claims 1, 10 and 11 including electropolishing produces the surprising, unexpected, and unobvious result of superior high temperature corrosion resistance through electrochemical modification only. This is fully supported by the attached Brady Declaration.

The invention of claims 1, 10 and 11 has also achieved other unexpected results. Prior to the invention of the claims, ferritic stainless steels had limited application in SOFCs. This was for a least two reasons. First, in order to maximize the efficiency of SOFCs, the interconnects must have good electrical conductivity. However, even when provided with "deformed" surfaces, ferritic stainless steels form a surface oxide layer having low electrical conductivity at SOFC operating conditions. Second, the scale that forms on ferritic stainless steels typically grows thicker with time, further decreasing the efficiency of the SOFC. Before the present inventor discovered the advantages of the composition and method of the claims, it was known to make an alloy that formed a highly electrically conductive scale or an alloy in which the scale thickened at an extremely slow rate. However, due to the underlying mechanism controlling these

properties, providing a steel with a surface that develops both an electrically conductive scale and a slow-growing scale could not be achieved. The present methods of claims 1, 10 and 11, however, produce a surface that develops a scale that is both electrically conductive and slow-growing when subjected to high temperature oxidizing conditions. The aluminum-rich oxide scale that forms on the steel of the claims under SOFC operating conditions is electrically conductive. The scale differs in its a_o and c_o lattice parameters from certain other alloys producing alpha Cr_2O_3, Fe_2O_3, and alpha Al_2O_3 scales. Producing a *ferritic stainless* steel that is both oxidation resistant and forms a slow-growing and electrically conductive scale when subjected to *high temperature* oxidation conditions is a surprising, unexpected, significant, and nonobvious result of practicing the method recited in claims 1, 10 and 11.

For the reason set forth above, Applicant respectfully requests withdrawal of the rejection of claims 7, 11-13, 16-22 and 25-26 under § 103 over Takehiro in view of Gamble and/or Faust.

5. Claims 1-5 and 9-10

Claims 1-5 and 9-10 stand rejected under § 103(a) as being unpatentable over U.S. Patent No. 5,228,932 to Shimizu et al. ("Shimizu"). Of these claims, claims 1 and 10 are the independent claims, and claims 2-5 and 9 ultimately depend from claim 1. Applicant traverses this rejection for the reasons set forth below.

Claims 1 and 10 require "electropolishing at least one surface of the ferritic stainless steel." Shimizu does not teach or suggest electropolishing. The Examiner has given no explicit rationale why one of ordinary skill in the art, when considering Shimizu alone, would electropolish a ferritic stainless steel. The Examiner cites Shimizu for teaching a "reduction of 50%." However, a reduction is not electropolishing and further does not remove material from the steel as alleged by the Examiner. One of ordinary skill in the art would know that "reducing" a steel means to apply force to a steel (usually through a roller) to deform the shape of the steel. This "reduces" the cross-sectional area of the steel piece being "reduced," but does not actually remove any steel from the piece. Regardless, Shimizu does not teach or suggest electropolishing.

Thus, the gap between the teachings in the cited references and the subject matter recited in independent claims 1 and 10 is "so great as to render the [claims] nonobvious to one reasonably skilled in the art," and withdrawal of the rejection of claims 1-5 and 9-10 is respectfully requested.

6. Claims 7, 11-13, 16-19 and 25-26

Claims 7, 11-13, 16-19 and 25-26 stand rejected under § 103(a) as being unpatentable over U.S Patent No. 5,228,932 to Shimizu et al. ("Shimizu") in view of U.S. Patent No. 2,692,853 to Gamble ("Gamble") and/or U.S. Patent No. 2,338,321 to Faust ("Faust"). Of these claims, claim 11 is the single independent claim. Applicant traverses this rejection for the reasons set forth below.

The Examiner relies on Shimizu to allegedly teach the chemical composition of the claimed steel in the same way that the Examiner relies on Takehiro in an earlier rejection. Shimizu does not teach electropolishing, however, and thus the Examiner also relies on Gamble and Faust in the same manner as the previous rejection in which he combines these references with Takehiro. The combination with Gamble and/or Faust, however, fails to cure the deficiency of Shimizu in the same way that Gamble and Faust fail to cure the fundamental deficiency of Takehiro, as discussed above. The combination of these references fails to establish that the presently rejected claims would have been obvious as discussed above in regard to the rejection over Takehiro, Gamble, and Faust.

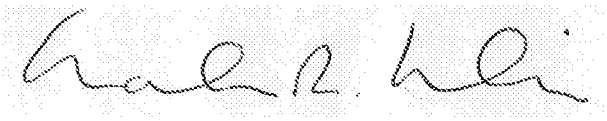
The rejection of claims 7, 11-13, 16-19 and 25-26 should be withdrawn.

Conclusion:

Applicant asserts that the claims of the Subject Application, as amended herein, are directed to subject matter that is patentable over the cited references. As such, Applicant respectfully requests that the Examiner enter the amendments submitted herein and issue a Notice of Allowance at an early date. If, however, the Examiner is of the opinion that the Subject Application is in condition for disposition other than allowance, Applicant respectfully requests that the Examiner contact Applicant's attorney at the telephone number listed below so that those concerns may be addressed.

Applicant's present response should not be taken as acquiescence to any of the specific rejections, assertions, statements, etc., presented in the Office Action that Applicant has not explicitly addressed herein. Applicant reserves the right to specifically address all such rejections, assertions, and statements in continuing applications, subsequent responses, and/or in appeal or pre-appeal proceedings.

Respectfully submitted,



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